AIRFIELD PAINT REMOVAL

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Paint removal is a process that, in this day and age of environmental controls, budget constraints and quality-control supervisors is difficult to define, let alone accomplish to everyone's satisfaction. Removal of paint from airfield pavements carries its own special qualifications in that the pavement must be preserved and the removal process cannot cause "serious" damage. Additionally, FOD, foreign object debris, must be avoided at all times due to the potential for damage to aircraft.

The old practice of covering obsolete markings on airfields with black paint is no longer an option. Moreover, those markings that have been "blacked out" over the years are also subject to the 139 Inspector's critical eye, demanding the conflicting marking to be removed. The FAA has stated under Section **3.d. Removal of Markings:**

> *Pavement markings that are no longer needed should be physically removed by sand blasting, chemical removal or other means, not painted over. Painting over the old markings merely preserves the old marking, will require additional maintenance, and in certain conditions, can be misleading to pilots.*[1]

PAINT REMOVAL SCENARIOS

- Over the years, you (or others) have blacked out old markings (taxiway lines, holding bars, runway markings) and you now have to remove those markings.
- You are in the process of changing traffic patterns at your airport, so the old conflicting markings will have to be removed, like changing the holding position marking pattern.
- By 2008, you will need to convert the old sized threshold bars to the new ICAO pattern.
- The runway is being extended, causing the markings on that end to shift.
- An asphalt overlay is being planned and the old markings must be removed so the new asphalt bonds well to the underlying surface.
- A seal coat is planned on some of the airfield pavement and new marking patterns are being installed. The old markings should be removed, not sealed in.
- You need to remark your pavement, but the old markings are so thick, they're peeling up, causing a FOD problem.
- You want to use a different marking material that is not compatible with the old; so the old paint must be removed.

Sooner or later, you will be faced with paint removal on your airfield pavement.

Having been in the highway and airfield marking industry for over 25 years, I've seen many methods used, some successfully, some not. I'm going to talk about the different methods and equipment currently being used in the industry. I will address the pros and cons of each method and try to give you enough information for you to determine the best method that would be suitable to your situation.

There are four points or **QUALIFIERS** that must be stated, though, before going into the finer points of paint removal:

1. The quality of any removal operation depends upon the operator of the equipment
2. Not all painted lines are the same
3. Not all surfaces are the same
4. Paint removal is not pretty, nor will it be "invisible"

Qualifier #1: the quality of any removal operation depends upon the operator of the equipment. Any method of paint removal can be used without serious damage to the pavement. On the other hand, in the hands of an inexperienced operator, serious damage can result.

Your pool of local pavement marking contractors available to you will be accustomed to working on parking lots and on highways where leaving a scar or damaging the pavement may not be the problem there that it is on an airfield. The biggest difference with the airfield is the potential of creating foreign object debris or FOD. So when contracting with a company to do paint removal, specify or find out what method is going to be used and write into the contract that the contractor will be held responsible for any serious damage to the pavement.

Qualifier #2: not all painted lines are the same. A single layer of paint is a lot easier to remove than multiple layers. Oil based paints, although no longer used, are still encountered in removal operations. They have "alligatored" the asphalt surface, making further damage during removal almost a certainty. Even water-based paints can be difficult to remove if applied with airless painting equipment. And then there's the stain that is left on concrete pavement from yellow, black or red pigments that refuse to budge.

Qualifier #3: not all surfaces are the same. On the same project calling for paint removal, for which the owner will most likely want one unit price, the contractor may encounter concrete (sometimes old and cracking, but usually in good condition), asphalt (sometimes a year or two old and quite resilient, but sometimes old, cracked and brittle), slurry seal or seal coat that has been applied over a poor pavement surface to extend the life of the pavement a little longer. The same equipment or combination of removal equipment may be used for all of these pavements, but **the length of time each takes will vary due to the care that must be taken to mitigate further damage.**

Qualifier #4: no paint removal method is pretty. Any method will leave <u>some</u> scar; but most scars will weather and fade in a relatively short period of time.

The goal of the contractor should be to remove the specified degree of paint while preserving the integrity of the pavement.

CLEARLY DEFINE THE SCOPE OF WORK AND EXPECTATIONS

In the design stages of a project, determine what type of paint removal and the degree of removal that needs to be done, i.e., what is the scope of work and the owner's expectations? Additionally, be aware of the pavement condition index (PCI) for the surface upon which the paint removal is to be done so that you have a base point for the pavement prior to commencing the removal operation. Try to get the contractor(s) to visit the work site to assess the condition of the pavement themselves or provide pictures for their review prior to the bid. OR determine what equipment can or cannot be used due to existing pavement conditions and make that part of the specifications for the project.

DEGREE OF REMOVAL

85% of Loose and Flaking paint. A clear distinction between "paint removal" and surface preparation prior to repaint needs to be made. Very often, specifications for an airfield striping project include an item for paint removal. But then when the specifications are carefully read, the paint removal is defined as removing "85% of loose and flaking paint". This is fine when there is not a heavy build up of old paint and when the markings are going to be placed in the same location. However, all too often, when the job is underway and only 85% of loose and flaking paint is removed, there is dissatisfaction on the part of the owner who was expecting the old paint to be 85% removed! The distinction that must be made is that 85% of loose and flaking paint means that the majority of loose paint will be removed prior to repainting; it is "surface preparation", not paint removal.

Indeed, surface preparation needs to be done prior to repainting. Most military specifications state that the surface to be painted shall be cleaned by "sweeping, blowing with compressed air, rinsing with water or a combination of these methods". The FAA states:

> "Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material which would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials."[2]

Have you ever had to paint your house or a fence where the underlying layers of paint had to be prepared first? Would sweeping it get off the loose paint? Would rinsing with water work? How about blowing with compressed air? Probably none of these methods would actually get the majority of loose and flaking paint off of the surface to be painted.

Based on my experience, if that is what the specifications say, that is what the contractor will do and then repaint the markings. As the new paint cures and bonds to the old paint, the underlying paint, if not well bonded, will detach from the surface due to the tension caused by the overlying paint film, will curl or bubble up and eventually loosen from the surface completely. This poses a potential FOD problem for airports and substantially reduces the life of the paint project. But using **paint removal equipment** to do surface preparation is beyond the scope of most specifications.

The remedy would be to require all markings that are to be repainted to be waterblasted using a minimum of 8,000 psi, shotblasted and/or milled sufficiently to remove 95% of the poorly bonded paint from the surface. This should dislodge most poorly bonded paint from the surface, ensuring a longer lasting paint project. The fact is, you cannot always tell by looking at markings to be repainted how they will respond to a fresh coat of paint. When I bid a project where markings on concrete are to be repainted, I almost always plan on waterblasting them first. And I have recently begun to figure on waterblasting old markings on asphalt as well due to an experience we encountered at Forbes Field in Topeka, KS. We had not intended on cleaning any of the asphalt paint prior to repainting, but when the waterblaster was cleaning the edgeline on the concrete and hit the edgeline on the asphalt, it came up easier than the paint on the concrete! So we ended up cleaning all of it! We had not figured the cost or time to do that level of surface preparation, but decided it would be in the best interest of the job and our reputation to do what we knew needed to be done.

REMOVE OLD LAYERS OF PAINT TO REDUCE BUILD-UP

There is a point at which continued repaints, particularly at airport facilities which have their own paint crews, will create a build up of layers of paint that should be removed after every five or six applications. The Air Force actually states in their Engineering Technical Letter 94-01 that "painted markings should not be allowed to build up beyond approximately 1.02 mm (40 mils) total thickness . . . Over-painting will eventually cause the marking to crack and peel."[3] When the paint thickness exceeds 40 mils**, the old layers of paint should be at least 85-90% removed** so that the surface is predominately free of any old paint.

Some of the more recent specifications have prescribed a grid measuring one-foot square and sectioned into 100 equal squares. The quality control measure is that at a specified removal rate of 85%, there can be 15 squares of "undisturbed" paint when the grid is randomly placed on the pavement where paint removal has occurred. At 90% removal, only 10 squares would be "undisturbed", and so on.

REMOVE PAINT UNDERLYING NEW COLOR BEING APPLIED

As with holding bars, when a new pattern or color of paint is being applied over a different pattern or color, the underlying paint must be removed. As we have been involved at several different airports enlarging holding position markings, we have been doing in the range of **90-95% paint removal** for this purpose.

REMOVE MARKINGS PRIOR TO ASPHALT OVERLAY OR SEALCOAT

Prior to an asphalt overlay or sealcoat, it is advisable to remove the old paint markings since they present a barrier between the new asphalt and the old asphalt surface to which it must bond. Customarily, **80-85% paint removal** is achieved prior to an overlay. However, if the pavement is to be milled prior to the overlay, the paint will be removed along with the pavement and a separate item for paint removal would not be required.

REMOVE OBSOLETE MARKINGS

If there are old, obsolete markings such as old taxiway lines that have been "blacked out", it is advisable to **remove 95-100%** of these markings, since these are the markings that can inadvertently mislead a pilot or driver while maneuvering on the AOA in poor weather conditions.

CHANGING MARKING PATTERN

When converting to the new ICAO threshold bars, you should be designing the project to **remove 90-95% of the conflicting paint.** But where the new pattern will coincide with the old, **the markings to be "repainted" could be removed as 85% of loose and flaking paint** or at a greater degree depending upon the needs of the owner. The lesser the degree of removal, the less the underlying pavement will be stressed, it will expedite the project and will reduce costs.

Most of the paint removal scenarios will fall into one or more of those categories. It is extremely important that the specifications clearly define the expectations of the owner/inspection team so that the contractor and bid and plan the work accordingly.

METHODS OF REMOVAL:

1. **Grinding or Milling**
2. **Sandblasting**
3. **Shotblasting**
4. **Waterblasting**
   - **4a. Low pressure waterblasting**
   - **4b. High pressure waterblasting**
   - **4c. Ultra high pressure waterblasting**
5. **Chemicals**

1. Grinding or Milling

Grinding machines or scarifiers are probably the most commonly used methods for removing paint from **asphalt surfaces**. There are different types of grinders with different grinding heads. Some have drums with rows of cutting teeth that spin around vertically, cutting or scoring the pavement and removing the paint in the process. Some have grinding heads that rotate both vertically and horizontally leaving a smoother looking scar, but the pavement has to be relatively level without depressions for these to be effective. If you have an old asphalt surface where there is considerable surface cracking, grinders are your best bet. Since grinders are scraping the surface only, there would be no worsening of the surface cracks. Their limitations, however, are that they can only remove the paint on the surface. If paint to be removed is on a grooved surface or on a severely cracked surface, the paint down in the depressions won't be touched.

Milling machines are generally equipped with larger heads on the same principle as the small grinders, but cut a larger path. Milling equipment can be used to remove paint when the surface is going to be resurfaced because the scar is quite visible and the cut generally greater than ¼ of an inch. But it is faster than grinders when removing large areas of paint. Large milling machines are used to remove a certain depth of asphalt prior to an asphalt overlay and will, coincidentally, remove the paint in the process.

Grinders leave an etched surface where the grinding teeth scored the asphalt. Although initially visible, the score marks disappear over time. However, if used on concrete, the score marks last a long time.

2. Sandblasting

Sandblasting is probably the least damaging method of removal to asphalt available because it is generally done by hand and can be controlled by the operator. The pressurized sandblast erases the paint from the surface and can concentrate the stream on difficult areas without adverse effects on the surrounding surface. The force of the sand usually does not damage cracked or spalled pavement unless the pavement is already crumbling. Sandblasting, however, is **very slow** and spreads sand everywhere. Protective gear must be worn to keep the worker safe from ricocheting sand and a respirator should be worn to prevent the silica in the sand from being inhaled by the worker. There are other abrasives that can be used that do not contain silica, such as "black beauty".

3. Shotblasting

Shotblasting is a method of removing paint from **concrete pavement**. Asphalt pavement is generally too "soft" to withstand the blast of the steel pellets without damage. Thousands of tiny beads of shot are propelled at the surface within a shrouded compartment that also contains a vacuum designed to recapture both the debris and the steel pellets. Some dust and shot does escape, but the majority is vacuumed into the machine. The operator is generally equipped with a bar magnet that can be dragged along the ground to pick up most of the stray shot. This equipment is best used on a non-grooved surface, as the shot will escape due to the vacuum seal being broken by the grooves. Shot can present a problem getting imbedded in the joint material: it won't come out and it will rust. Shotblasters are generally self propelled, cut a path from 6-inches to 20-inches wide, depending upon the size of the head and the machine and can remove up to 2000 SF per hour.

The "Skid-a-brator" is a large truck-mounted shotblasting machine that is often contracted to retexture a pavement surface that has experienced a reduction in friction coefficients. Coincidentally, this equipment will remove anything in its path, including paint. It is most frequently used by state DOT's to retexture road surfaces.

4. Waterblasting

There are many different types of waterblasting equipment, from pressure washers with water pressures of 2,000 psi to ultra high concrete demolition units at 43,000 psi. Then there are waterblasting units that are high volume/medium pressure (30 gpm/10-15,000 psi) to low volume/ultra high pressure (8gpm/35-40,000 psi). There are systems that are low pressure with hot water and others that use abrasives in the water stream to cut more effectively.

I'm going to focus on three types for the purposes of this presentation:

a. "Low" pressure waterblasting

Low pressure waterblasting would most likely be a tow-behind, trailer mounted waterblaster capable of attaining up to 10,000 psi. The volume of water would be in the range of 15-20 gallons per minute, flowing through a hand-held wand with single fan tip, laser tip or rotating tip. This process would be slow because of the single stream of water, but could remove a light coating of paint or even curing compound from new concrete.

b. "High" pressure waterblasting

High pressure waterblasting is a unit with pressures ranging between 5,000 to 15,000 psi. It has a high volume of water (22-30 gpm) flowing through rotary bars suspended within a pan that is either pushed or is truck mounted. It slowly moves along the pavement with the rotor bars spinning from 500-3000 rpm. The small nozzles within the rotor bar direct the pressurized streams of water onto the surface, pulverizing the paint as it moves. The nozzles can be arranged or the pan oriented to cut 6 inches or up to 24-36 inches. This equipment is used for removing rubber deposits from either asphalt or concrete (at around 8,000 psi), but is also very effective in removing paint from **concrete surfaces** as well as **some asphalt surfaces** (from 8-15,000 psi).

An asphalt surface has to be in reasonably good condition when this equipment is used to remove paint. If badly cracked or if the asphalt binder is old and brittle, the heavy volume of water will act hydraulically, leaving cracks wider and expose more aggregate by blasting away the brittle binder. When this equipment works on concrete or good asphalt, it can remove paint at a rate of up to 3000 SF per hour.

Hand held wands can also be used up to 20,000 psi and can concentrate the stream of water through a single fan tip, laser tip or rotating tip onto a specific area to be removed. Like sandblasting, the hand held wand is a very slow process, but is less damaging to the surface since the wand can be guided around cracks or spalls.

c. **Ultra-high pressure waterblasting**

This equipment looks very similar to "high" pressure waterblasting equipment in that it is generally truck mounted, using rotary bars spinning between 500-3000 rpm. The difference is in the pump and in the spray nozzles. Pressures generally range from 25,000-40,000 psi and the volume of water used is only 4 to 8 gpm. With the low volume of water under those pressures, the result is that the water jets do not penetrate the surface with the hydraulic effect of the "high" pressure equipment. There is more of a milling effect, with the pressure concentrated within 1-3 inches from the nozzles. Further away, the high pressure has little effect.

This equipment is effective in removing paint from either **concrete or asphalt.** Even on older asphalt, paint can be removed without serious damage because the spray does not penetrate the pores and cracks found in aging asphalt. There will be some erosion of the asphalt binder and some exposed aggregate, but generally the damage is not severe. Paint removal rates, depending upon the thickness of the paint, can be as high as 2000 SF per hour. The equipment will even remove the paint from a grooved runway surface without damage to the grooves.

5. Chemicals

There are chemicals on the market that are environmentally safe that can be used to soften paint prior to removal by waterblasting. Then there are chemicals that are not environmentally safe that can be used as long as the debris and water are all contained in the paint removal operation. Most chemicals will only soften the paint; it will still need to be removed by some other method. However, it may be helpful in a situation where the pavement surface is in poor condition. The chemical will soften the paint thus reducing the need for higher water pressures when removing the paint. There is a dramatic increase in cost when using chemicals: from the cost of the material . . .to the labor to apply the chemical . . .to the time needed to have the chemical "work" . . . to the clean up, containment, testing or characterizing of the debris and subsequent disposal.

DIFFERENT TYPES OF PAVEMENT SURFACES

ASPHALT

Any removal operation on asphalt will leave an immediate, visible "scar". The paint that was on the pavement protected the pavement from the oxidation process that already happened to the surrounding pavement, thus making the newly exposed pavement dark by comparison. This is generally the case when waterblasting, sandblasting or chemicals are used. But that pavement,

once exposed to the elements, will undergo the same oxidation process and eventually blend into the surrounding pavement without any visible difference. Asphalt is "softer" than concrete and more susceptible to damage with any removal operation. If the asphalt is relatively new (5 years old or less) there will be more binder still in tact holding the aggregate. This surface would sustain waterblasting or sandblasting very well. As the asphalt ages, the binder wears away, leaving aggregate exposed; surface cracks and even potholes begin to form. The aged asphalt surface would have to be evaluated to determine the best method or combination of methods of paint removal.

CONCRETE

Concrete is much more forgiving in a paint removal operation than asphalt. Except for grinders (which can be used, but sparingly), any of the other removal methods can be used. The "scar" or mark on concrete left after removing paint is simply clean pavement. Concrete airfield pavements are susceptible to stains from molds, mildew, etc., particularly in humid environments. While removing paint, the equipment used will also clean the stains, leaving a clean swath of pavement in its path. Shotblasters may leave a dimpled surface, grinders will leave "teeth" scars, sandblasters and waterblasters will leave a path where the sand or water hit the pavement. In some cases where the existing paint is multi-layered, the removal equipment might have to make several passes over an area to remove the paint, and there may be some aggregate in the pavement exposed.

SUMMARY

Paint removal at most airports around the country is or will be necessary over the next several years and probably for the foreseeable future. The effectiveness of various methods available in the industry depends upon many factors: from the type and condition of the pavement from which the paint is being removed to the degree of removal and end result desired.

- Be as specific as you can when writing the specifications for a paint removal project, defining expectations and the degree of removal desired.
- Provide pictures of the paint to be removed as well as pictures of the pavement OR require a mandatory pre-bid meeting for any prospective bidders to attend so that each can determine the best method to be employed to comply with contract specifications.
- If you are putting out a contract for repainting the airfield markings, determine the degree of **surface preparation** required prior to painting. If more than six layers of paint have been applied since the pavement was new or since the paint was previously removed, consider removing 85%-90% of the existing paint prior to repainting the markings.
- Every paint removal project is different; you cannot always determine what paint is going to give up easily and what paint is going to hang on tightly.
- No paint removal method will leave the surface "like new". There will be some evidence, at least initially, of the old marking.
- Using the right equipment with experienced operators can mitigate the scarring of the pavement and prevent serious damage.

[1] FAA Advisory Circular AC 150/5340-1H, dated 8/31/99
[2] FAA Advisory Circular AC 150/5370-10A, Change 12, dated 2/22/99, Section 620-3.3, **Preparation of Surface**
[3] Dept. of the Air Force, HQ AFCESA/EN, Engineering Technical Letter (ETL) 94-01 dated 5 APR 1991, Section 1.3.4.